

FISHERY DATA SERIES NO. 82

STOCKINGS, MIGRATIONS, AND
AGE, SEX, AND LENGTH COMPOSITIONS
OF COHO, SOCKEYE, AND CHINOOK
SALMON IN RESURRECTION BAY,
ALASKA, DURING 1988¹

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ABSTRACT

During 1988, Bear Lake was stocked with 347,173 hatchery-reared coho salmon *Oncorhynchus kisutch* fingerlings of Bear Lake origin and Seward Lagoon and Lowell Creek were stocked with 118,741 and 63,806 hatchery-reared coho salmon smolts of Bear Lake origin, respectively. In addition, Seward Lagoon and Lowell Creek were stocked with 109,020 and 95,673 hatchery-reared chinook salmon *Oncorhynchus tshawytscha* smolts of early-run Crooked Creek origin, respectively.

The emigrations of coho and sockeye *Oncorhynchus nerka* salmon smolts from Bear Lake during 1988 totalled 63,830 and 9,145 smolts, respectively. After trap mortalities, 63,775 live coho salmon smolts and 9,141 live sockeye salmon smolts were released downstream. The majority of the coho and sockeye salmon smolts were age 1.0 (79.2 and 78.6 percent, respectively). A total of 2,174 adult coho salmon and 106 adult sockeye salmon returned to Bear Lake. The majority of the returning coho salmon were age 1.1 (83.3 percent) and the majority of the returning sockeye salmon were age 1.2 (47.8 percent) and age 1.3 (39.6 percent). An estimated 228 coho salmon returned to Seward Lagoon during 1988. Sixty percent of this return originated from the hatchery-reared smolts stocked into Seward Lagoon during 1987, 23 percent from hatchery-reared smolts stocked into Lowell Creek during 1987, and 17 percent from wild stock production in the lagoon.

The estimated marine (smolt-to-adult) survival rates of coho salmon emigrating from Bear Lake during 1987 and stocked into Seward Lagoon and Lowell Creek during 1987 were 3.5, 6.6, and 5.8 percent, respectively.

KEY WORDS: Coho salmon, *Oncorhynchus kisutch*, Resurrection Bay, Bear Lake, chinook salmon, *Oncorhynchus tshawytscha*, sockeye salmon, *Oncorhynchus nerka*, migrations, age, length, sex, survival, weir.

INTRODUCTION

The recreational fishery in Resurrection Bay is one of the largest marine sport fisheries in effort and harvest in Alaska (Mills 1988). Historically, most of the effort in this fishery has been by private boat anglers targeting coho salmon *Oncorhynchus kisutch*. A growing charter boat industry has also developed in recent years. Effort in this fishery has averaged nearly 7,400 boat-trips annually from 1968 to 1988 (Carlson and Vincent-Lang in press) with harvests of coho salmon during this period having averaged about 15,600 coho salmon annually. In addition to the boat fishery, anglers also fish from shore for coho salmon. Effort and harvest in this fishery, although increasing annually, are minimal compared to the boat fishery.

To increase and stabilize the numbers of coho salmon available to the sport fisheries in Resurrection Bay, a stocking program for coho salmon was initiated in 1962 (Figure 1). Bear Lake was chosen as the initial focus of the stocking effort. To increase the rearing capacity of the lake for young coho salmon, the lake was rehabilitated to eradicate competing threespine stickleback *Gasterosteus aculeatus* and an annual stocking of coho salmon fingerlings was begun. Survivals of fingerlings to smolt from these efforts have averaged 35% since 1971. Bear Lake also supports a small run of sockeye salmon *O. nerka* which, in past years, has contributed to both commercial and personal-use fisheries. Vincent-Lang (1987) presents a complete summary of past stocking activities in Bear Lake with recommendations for future stockings. In accordance with the recommendations stipulated in Vincent-Lang (1987), Bear Lake was stocked with 347,173 age 0 coho salmon fingerlings of Bear Lake origin during 1988 (Table 1).

Further stockings of coho salmon in Resurrection Bay began in 1968 with annual releases of hatchery-reared smolts of Bear Lake origin at additional sites. Release sites have included Seward Lagoon, the Lowell Creek outfall, Grouse Lake, and Bear and Box Canyon Creeks (Figure 1). In 1988, Seward Lagoon and Lowell Creek received 118,741 and 63,806 age 1 hatchery-reared coho salmon smolts of Bear Lake origin, respectively (Table 1). Hatchery-reared chinook salmon *O. tshawytscha* smolts have also been released annually since 1983 in an effort to lengthen and diversify the Resurrection Bay sport fishery. In 1988, 109,020 and 95,673 age 0 hatchery-reared chinook salmon smolts of early-run Crooked Creek origin were released at Seward Lagoon and Lowell Creek, respectively (Table 2).

In conjunction with the stocking program, the Alaska Department of Fish and Game, Sport Fish Division, has conducted an ongoing research program with the objectives of: (1) monitoring effort and harvest in the sport fisheries in Resurrection Bay; (2) estimating the return of stocked fish; and, (3) determining the most effective stocking strategies. These objectives have principally been accomplished through research aimed at monitoring the three major life history events of stocked salmon in the Resurrection Bay drainage: (1) freshwater residency and emigration; (2) harvest in the sport fishery; and, (3) immigration. Objectives (1) and (3) are currently accomplished by operating weirs on the outlets of Bear Lake and Seward Lagoon (Figure 1) to collect data needed to estimate the abundance and biological characteristics (age, sex, and size composition) of the smolt emigrations (Bear Creek only) and the

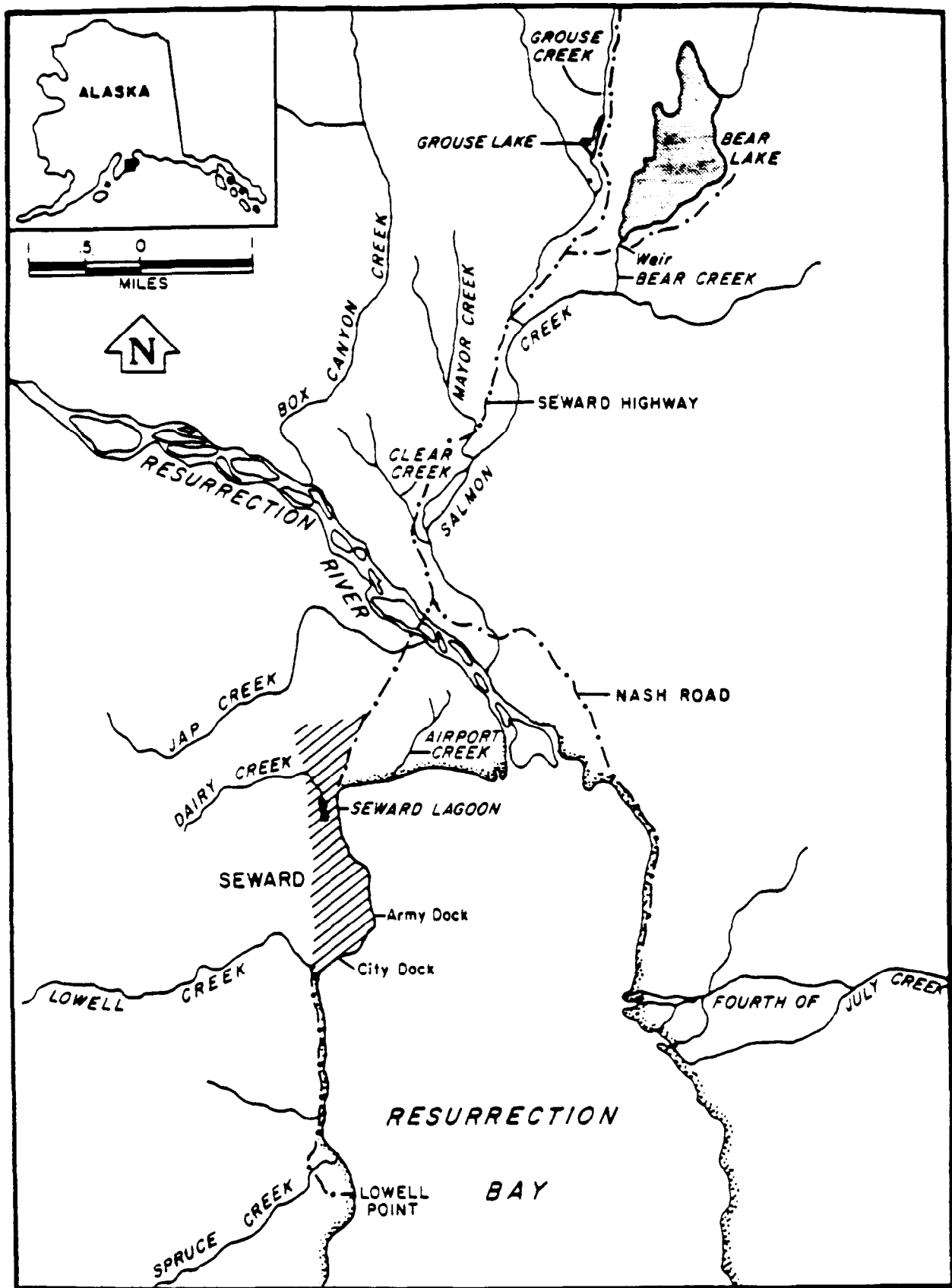


Figure 1. Map of Resurrection Bay, Alaska.

Table 1. Coho salmon fingerlings and hatchery-reared smolts of Bear Lake stock released in Resurrection Bay tributaries, 1988.

Brood Year	Type of Release ¹	Release Date	Release Location	Stocking Data				Mark Type	No. Fish Marked
				No. Fish Released	Density (No./Ha)	Weight (Kgs)	Size (No./Kg)		
1987	F	6/02	Bear Lake	347,173	1,927	348	999	AD-CWT	67,063 ²
1986	S	5/23, 5/25	Seward Lagoon	118,741	28,743	2,644	45	AD-CWT	17,666 ³
1986	S	5/24, 6/02	Lowell Creek Outfall	63,806		1,360	47	AD-CWT	14,177 ⁴

¹ F = Fingerling release, S = Smolt release.

² Adipose finclipped and coded wire tagged; 0.5 mm tag code 3B/2/5.

³ Adipose finclipped and coded wire tagged; 1.0 mm tag codes A31 18/6 and A31 17/44.

⁴ Adipose finclipped and coded wire tagged; 1.0 mm tag code A31 18/7.

Table 2. Chinook salmon smolts of early-run Crooked Creek origin released in Resurrection Bay tributaries, 1983-1988.

Brood Year	Release Date	Release Location	No. Smolts Released	Stocking Data		Mark Type	Number Smolts Marked
				Weight (Kgs)	Size (No./Kg)		
1982	5/27/83	Box Canyon Rearing Pond	54,500	477	114	None	
1983	6/14/84	Thumb Cove	70,000	1,586	44	None	
1983	6/19/84	Lowell Creek Outfall	40,600	1,026	40	None	
1984	6/6-6/7/85	Lowell Creek Outfall	132,700	2,281	58	None	
1984	6/13/85	Seward Lagoon	53,250 ¹			Ad-CWT ²	53,001
1985	6/13/86	Lowell Creek Outfall	101,000	1,422	71	None	
1986	6/02/87	Lowell Creek Outfall	95,963	1,484	65	None	
1987	6/01/88	Seward Lagoon	109,020	1,788	61	None	
1987	6/02/88	Lowell Creek Outfall	95,673	1,599	60	None	

¹ Late-run Kenai River brood source.

² Adipose finclipped and coded wire tagged; tag code B4-14-13.

adult salmon immigrations. Objective (2) is currently accomplished through a creel survey designed to estimate angler-effort and harvest of coho salmon by the sport fishery in Resurrection Bay, the biological characteristics of harvested salmon, and the site-specific contribution of stocked salmon to the harvest.

Data collected for research objectives (1) and (3) are summarized in this report. Creel survey data are summarized by Carlon and Vincent-Lang (in press). Vincent-Lang (1987) presents a complete summary of past stocking activities in Resurrection Bay, including estimates of survival rates and contributions to the sport fishery.

METHODS

The weir on the outlet of Bear Lake is a complete barrier to upstream and downstream fish migration. The weir is located on Bear Creek, 0.5 km downstream from the outlet of Bear Lake. All emigrating salmon smolts and returning salmon adults captured at the weir were held in a live trap until they could be sorted by species, counted, and sampled for biological data.

The weir on the outlet of Seward Lagoon is a complete barrier only to the upstream migration of salmon. All returning salmon were held in a live box until they could be sorted by species, counted, and sampled for biological data.

Salmon Emigration

Abundance and timing of the emigrations of coho and sockeye salmon smolts from Bear Lake were determined by daily sampling of a downstream-migrant trap at the weir. Trapped smolts were dip-netted from the holding trap, anesthetized in a solution of water and MS-222, sorted by species, and counted before being released into calm water to recover and resume their downstream migration.

The age, length, and weight characteristics of the coho and sockeye salmon smolt emigrations from Bear Lake were estimated by randomly sampling emigrating smolts during designated temporal strata. Smolts selected for sampling were anesthetized, scale sampled, and the fork length was measured to the nearest 1 millimeter (mm). A subsample of smolts was weighed to the nearest 1 gram. Scale smears were mounted on adhesive-coated cards. The cards were thermohydraulically pressed against acetate cards and the resulting scale impressions were displayed on a microfiche projector for age determination.

Age compositions of the coho and sockeye salmon smolt emigrations were estimated by temporal stratum. For each species, the total number of emigrants during a stratum was multiplied by the estimated age composition to estimate the total number of emigrants by age group.

Letting \hat{p}_{ij} be the estimated proportion of age group i in stratum j , the variance of the estimated number by age group was calculated as follows (Scheaffer et al. 1979):

$$V(\hat{N}_{ij}) = N_{Tj}^2 [\hat{p}_{ij}(1-\hat{p}_{ij})/(n_{Tj}-1)] [1 - (n_{Tj}/N_{Tj})] \quad (1)$$

where:

\hat{N}_{ij} = the estimated number of smolts of age group i emigrating during stratum j,
 N_{Tj} = the total number of smolts emigrating during stratum j, and
 n_{Tj} = the total number of smolts sampled during stratum j.

Seasonal totals for estimated numbers and variances are the sums of these quantities over all strata. Estimates of means and standard errors for length and weight were calculated using standard normal procedures.

Salmon Immigration

Abundance and timing of the immigrating coho and sockeye salmon returning to Bear Lake were determined by daily sampling of these fish in the upstream-migrant trap at the weir. Fish were dip-netted from the trap, sorted by species, counted, examined for sex and finclips (coho salmon only), and released upstream. All adult coho salmon surplus to egg-take requirements were allowed to migrate into Bear Lake for natural spawning.

The age, sex, and length characteristics of the coho and sockeye salmon immigrations returning to Bear Lake were estimated by randomly sampling returning adults during designated temporal strata. Adults were scale sampled, the sex identified, any finclips noted, and the mid-eye to fork-of-tail length was measured to the nearest 5 millimeters. Scales were removed from the preferred area (Clutter and Whitesel 1956), mounted on adhesive-coated cards, and processed following the procedures described for the smolt scale samples. The age composition and mean length at age by sex of the salmon immigrations were estimated using the procedures described for the salmon smolts.

The abundance and timing of the immigrations of coho, chinook, and sockeye salmon returning to the Seward Lagoon system were determined by daily sampling of these fish in the upstream-migrant trap at the weir. All held salmon were counted by species, checked for finclips (chinook and coho salmon only), and released upstream. Because the weir was vandalized on several occasions, a total escapement to the Seward Lagoon system by species could not be obtained. For this reason, foot surveys of the Seward Lagoon system were also conducted to more accurately enumerate the escapement. The site-specific contribution of stocked and wild fish to the Seward Lagoon escapement was estimated using the procedure of Clark and Bernard (1987).

Minimum spawning escapements of coho salmon to Bear, Box Canyon, Mayor, Jap, Clear, and Grouse Creeks (Figure 1) were determined by periodic foot surveys conducted from mid-October to early November. Both live and dead coho salmon observed during the surveys were counted. Carcasses were examined for finclips and then mutilated to preclude recounting. Heads were removed from all adipose finclipped coho salmon carcasses to determine the extent of straying from their original stocking sites. Minimum coho salmon escapements were

determined by adding mortalities observed during previous foot surveys to the last live spawner count in each tributary.

Estimation of Marine Survival Rates

The marine (smolt-to-adult) survival rate of coho salmon smolts emigrating from Bear Lake (S_{BL}) during 1987 was estimated as:

$$\hat{S}_{BL} = (E_{BL} + \hat{C}_{BL}) / M_{BL} \quad (2)$$

where:

E_{BL} = the escapement of coho salmon to the Bear Lake weir in 1988,

\hat{C}_{BL} = the estimated harvest of Bear Lake fish in the Resurrection Bay sport fisheries during 1988, and

M_{BL} = the number of emigrating coho salmon smolts at Bear Lake weir in 1987.

The variance of this estimate was calculated as:

$$V(\hat{S}_{BL}) = V(\hat{C}_{BL}) / M_{BL}^2$$

where the variances of the coho salmon immigration and smolt emigration are assumed to be zero as they are completely enumerated.

The marine survival rate for coho salmon smolts stocked in Seward Lagoon during 1987 was estimated as for Bear Lake except:

E_{SL} = the escapement of stocked coho salmon to Seward Lagoon in 1988 (the estimated proportion of returning wild fish in the escapement was substrated from the total escapement to determine escapement of stocked fish to Seward Lagoon),

\hat{C}_{SL} = the estimated harvest of Seward Lagoon fish in the Resurrection Bay sport fisheries during 1988, and

M_{SL} = the number of smolts stocked into Seward Lagoon during 1987.

A minimum estimate of the marine survival rate for coho salmon smolts stocked into Lowell Creek was calculated as described above for Seward Lagoon with the exception that E_{SL} could not be defined and was considered to be zero. A waterfall at the Lowell Creek outfall physically precludes spawning in Lowell Creek. Those fish surplus to the harvest stray to other systems or perish in saltwater. The associated survival rate for these smolts is therefore a minimum estimate.

RESULTS

Salmon Emigration

The emigration of coho salmon smolt from Bear Lake during 1988 totaled 63,830 (Appendix Table 1). After trap and marking mortalities, 63,775 live smolts were released downstream. The emigration in 1988 was comparable in run timing to the historical emigration of coho salmon smolt from Bear Lake (Figure 2). The live emigration was composed of an estimated 50,492 (79.2%) age 1.0¹ and 13,283 (20.8%) age 2.0 smolts (Table 3). The mean length of age 1.0 and age 2.0 smolts increased throughout the emigration (Table 4).

The sockeye salmon smolt emigration from Bear Lake during 1988 totaled 9,145 smolts (Appendix Table 1), of which 9,141 live smolts were released downstream. The run timing of the emigration in 1988 fell within the range of the historical emigration of sockeye salmon smolt from Bear Lake (Figure 2). The live emigration was composed of an estimated 7,181 (78.6%) age 1.0 smolts, 1,930 (21.1%) age 2.0 smolts, and 30 (0.3%) age 3.0 smolts (Table 5). The mean length of sockeye salmon smolts remained relatively constant throughout the emigration (Table 6).

Salmon Immigration

The immigration of coho salmon to the Bear Creek weir during 1988 totaled 2,174 fish. Males (51%) and females (49%) were about equally represented in the return (Appendix Table 2). There were 814 Ad-CWT² marked (37.4%) and 1,360 (62.6%) unmarked fish in the immigration. After trap and egg-take mortalities, 955 male and 685 female coho salmon were released upstream to Bear Lake. The mean fecundity estimate for the 378 female coho salmon used for the egg take in 1988 was 4,319 eggs per female. The run timing of the immigration during 1988 fell within the range of the historical immigration of coho salmon to Bear Lake, but peaked earlier than the historical average (Figure 3). The immigration was composed of an estimated 1,811 (83.3%) age 1.1 adults, 341 (15.7%) age 2.1 adults, 15 (0.7%) age 2.0 jacks, and 7 (0.3%) age 1.0 jacks (Table 7). Lengths of age 1.1 male and female coho salmon in the Bear Lake immigration averaged 577 mm and 602 mm, respectively, and lengths of age 2.1 males and females averaged 610 mm and 631 mm, respectively (Table 8). Minimum estimates of escapements of coho salmon to Bear Creek downstream from the weir as well as to other index tributaries in the Resurrection Bay drainage are presented in Table 9.

The immigration of sockeye salmon to the Bear Creek weir during 1988 totaled 106 adults (Appendix Table 3). All 106 adults (54 males and 52 females) were released upstream. The run timing of the immigration during 1988 approximated

¹ European formula: Number preceding the decimal refers to the number of freshwater annuli, number following the decimal is the number of marine annuli. Total age from brood year is the sum of these two numbers plus one.

² Adipose finclipped and coded wire tagged.

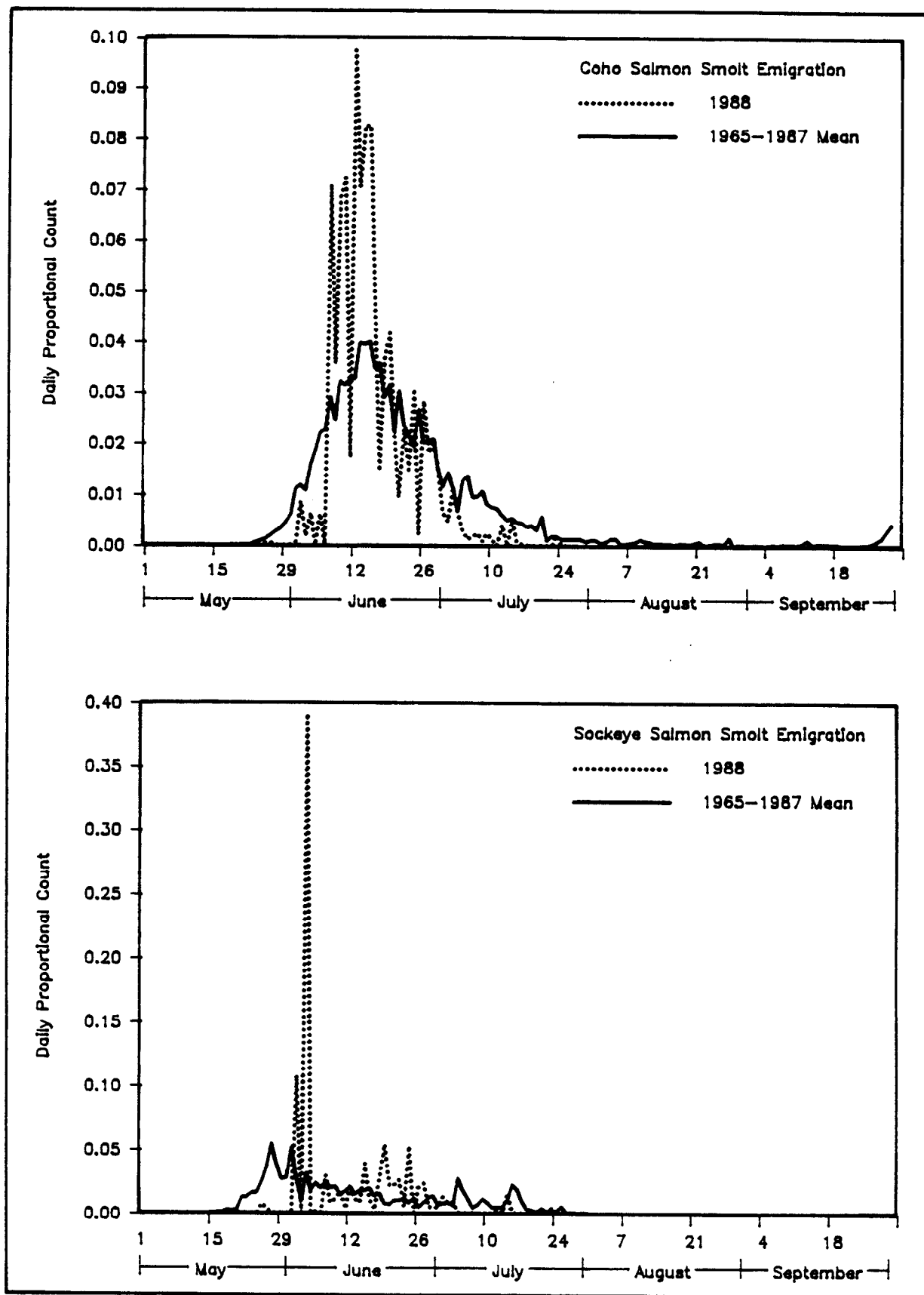


Figure 2. Migrational timings of the 1988 coho and sockeye salmon emigrations through Bear Creek weir compared to the historical emigrational timings of these species.

Table 3. Estimated abundance, by age group, of coho salmon smolts emigrating through the Bear Creek weir, 1988.

Period ¹		Age Group		Total
		1.0	2.0	
5/16-6/08 (n = 156)	Percent	88.5	11.5	100.0
	Estimated Number	5,436	706	6,142
	Standard Error	156	156	
6/09-6/15 (n = 137)	Percent	73.7	26.3	100.0
	Estimated Number	20,907	7,461	28,368
	Standard Error	1,068	1,068	
6/16-6/29 (n = 170)	Percent	80.0	20.0	100.0
	Estimated Number	19,942	4,986	24,928
	Standard Error	764	764	
6/30-8/12 (n = 167)	Percent	97.0	3.0	100.0
	Estimated Number	4,207	130	4,337
	Standard Error	56	56	
Total (n=630)	Percent	79.2	20.8	100.0
	Estimated Number	50,492	13,283	63,775 ²
	Standard Error	1,324	1,324	

¹ n = number sampled.

² A total of 63,830 coho salmon smolts emigrated from Bear Lake in 1988. Trap mortalities accounted for 55 coho salmon smolts; 63,775 live smolts were released downstream.

Table 4. Mean fork length (mm) and weight (g) of coho salmon smolts sampled at the Bear Creek weir, 1988.

Period		Age Group			
		1.0		2.0	
		Length	Weight	Length	Weight
5/16-6/08	Mean	105.8		127.6	
	Standard Error	0.6		4.3	
	Sample Size	138		18	
6/09-6/15	Mean	113.1		132.2	
	Standard Error	1.2		1.6	
	Sample Size	101		36	
6/16-6/29	Mean	118.3	16.4	133.2	22.3
	Standard Error	1.0	0.5	1.6	0.7
	Sample Size	136	58	34	27
6/30-8/12	Mean	121.9		145.8	
	Standard Error	0.6		10.2	
	Sample Size	162		5	

Table 5. Estimated abundance, by age group, of sockeye salmon smolts emigrating through the Bear Creek weir, 1988.

Period ¹		Age Group			Total
		1.0	2.0	3.0	
5/16-6/04 (n = 143)	Percent	83.9	16.1		100.0
	Estimated Number	3,916	750		4,666
	Standard Error	142	142		
6/05-6/13 (n = 114)	Percent	83.3	16.7		100.0
	Estimated Number	694	139		833
	Standard Error	27	27		
6/14-8/12 (n = 119)	Percent	70.6	28.6	0.8	100.0
	Estimated Number	2,571	1,041	31	3,642
	Standard Error	150	149	31	
Total (n = 376)	Percent	78.6	21.1	0.3	100.0
	Estimated Number	7,181	1,930	30	9,141 ²
	Standard Error	208	208	30	

¹ n = number sampled.

² A total of 9,145 sockeye salmon smolts emigrated from Bear Lake in 1988. Trap mortalities accounted for 4 sockeye salmon smolts; 9,141 live smolts were released downstream.

Table 6. Mean fork length (mm) and weight (g) of sockeye salmon smolts sampled at the Bear Creek weir, 1988.

Period		Age Group					
		1.0		2.0		3.0	
		Length	Weight	Length	Weight	Length	Weight
5/16-6/04	Mean	118.9		153.2		211.0	
	Standard Error	1.0		2.9			
	Sample Size	120		23		1	
6/05-6/13	Mean	116.3		153.7			
	Standard Error	0.9		4.4			
	Sample Size	95		19			
6/14-6/21	Mean	120.3	16.0	155.1	34.9		
	Standard Error	1.3	0.7	3.0	2.3		
	Sample Size	84	63	34	26		

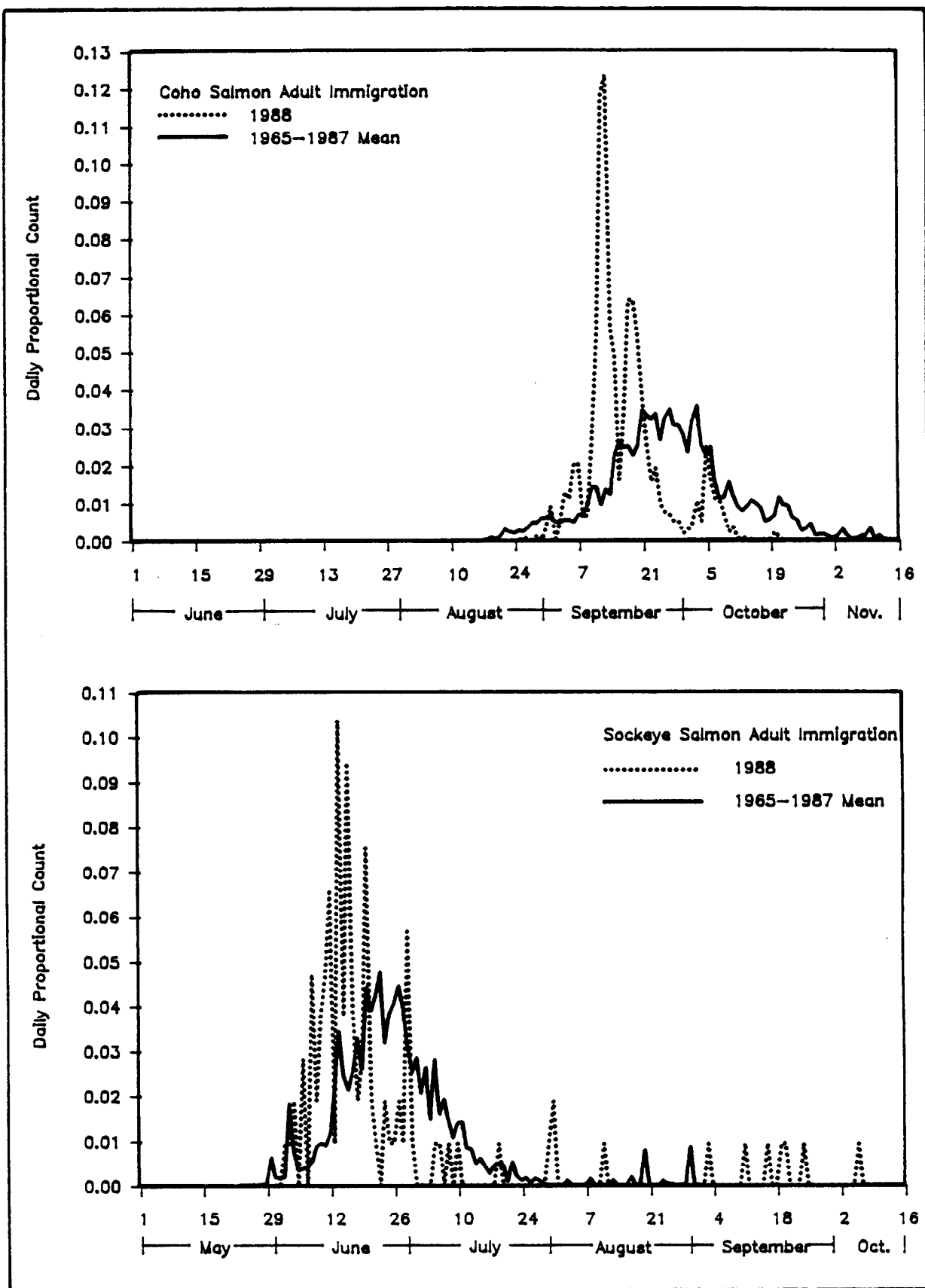


Figure 3. Migrational timings of the 1988 coho and sockeye salmon immigrations through Bear Creek weir compared to the historical immigrational timings of these species.

Table 7. Estimated abundance, by age group, of the coho salmon immigration through the Bear Creek weir, 1988.

Sex		Age Group				Total
		1.0	1.1	2.0	2.1	
Male	Percent	0.3	43.1	0.7	3.6	47.7
	Estimated Abundance	7	937	15	78	1,037
	Standard Error	6	57	10	22	
Female	Percent		40.2		12.1	52.3
	Estimated Abundance		874		263	1,137
	Standard Error		57		38	
Total (n=306) ¹	Percent	0.3	83.3	0.7	15.7	100.0
	Estimated Abundance	7	1,811	15	341	2,174
	Standard Error	6	43	10	42	

¹ n = number sampled.

Table 8. Mean length¹ (mm), by sex and age group, of adult coho salmon sampled at the Bear Creek weir, 1988.

Sex		Age Group			
		1.0	1.1	2.0	2.1
Male	Length	290	577	320	610
	Standard Error		5	25	19
	Sample Size	1	132	2	11
Female	Length		602		631
	Standard Error		5		10
	Sample Size		123		37

¹ Length measured from mid-eye to fork-of-tail.

Table 9. Summary of coho salmon escapement counts for Resurrection Bay tributaries foot surveyed in 1988.

Stream	Minimum Escapement	Carcasses		
		Number Examined	Number Marked ¹	Number Unmarked
Lower Bear Creek	18	0		
Box Canyon Creek	36	9	0	9
Seward Lagoon System ²	228 ³	84	30 ⁴	54
Clear Creek	121	13	1 ⁵	12
Mayor Creek	72	50	2 ⁶	48
Grouse Creek	158	14	0	14
Jap Creek	229	39	3 ⁷	36

¹ Marked with an adipose fin clip.

² Seward Lagoon system includes Dairy Creek, Pasture Creek, Railroad Creek, and First Lake Creek.

³ Due to vandalism of the Seward Lagoon weir, an undetermined number of fish were allowed to pass undetected during several days; determination of absolute escapement was not possible. The minimum escapement of 228 was determined by foot survey. Also, 24% of the escapement to the Seward Lagoon system is presumed due to natural production leaving a estimated minimum escapement of 171 enhanced fish.

⁴ Of the 30 marked fish sampled, 21 originated from the 1987 Seward Lagoon smolt release and 9 originated from the 1987 Lowell creek smolt release.

⁵ A CWT was not present in this marked fish.

⁶ Both marked fish originated from the 1987 Lowell Creek smolt release.

⁷ All 3 marked fish originated from the 1987 Lowell Creek smolt release.

the historical average timing, although the peak occurred earlier than average and solitary sockeye salmon continued to reach the weir from early July through early October (Figure 3). The estimated age composition of the immigration during 1988 was 50 (47.8%) age 1.2, 43 (39.6%) age 1.3, 8 (8.4%) age 2.3, 3 (2.8%) age 2.2, and 2 (1.4%) age 0.3 adults (Table 10). Sockeye salmon mean lengths ranged from 478 mm for age 2.2 females to 586 mm for age 2.3 males (Table 11).

A total of 153 coho salmon adults were passed through the Seward Lagoon weir between 21 August and 28 October (Appendix Table 4 and Figure 4), of which 48 fish (31.4%) were Ad-CWT marked. Because the weir was vandalized throughout the field season, fish were allowed to pass undetected during two 4-day periods and during portions of several other days. Subsequent foot surveys indicated a minimum escapement to the system of 228 adults of which 35.7% were Ad-CWT marked (Table 9). Coded wire tag analysis of Ad-CWT marked fish in this escapement indicated that 60% of the return (137 fish, standard error of 25 fish) originated from the 1987 release of hatchery-reared smolts into the lagoon and 23% (53 fish, standard error of 15 fish) from the 1987 release of hatchery-reared smolts at Lowell Creek. The remaining 17% of the escapement (38 fish) was likely from wild stock production in the lagoon.

Baseline data concerning straying of returning hatchery adult coho salmon indicate that some coho salmon smolts released at the Lowell Creek outfall in 1987 strayed to other systems upon returning to the Resurrection Bay drainage as adults. Snouts were collected from a total of 145 marked fish found during egg takes at the Bear Creek weir and during escapement surveys on four other creek systems. Coded wire tag analysis revealed that of 109 marked fish sampled at the Bear Creek weir, 108 had originated from Bear Lake and only one had originated from a stray (the 1987 Lowell Creek smolt release). The remaining 36 marked fish were sampled during foot surveys of escapements to various other creeks (Table 9). Of 30 marked fish sampled from the Seward Lagoon return, 21 had originated from Seward Lagoon and 9 originated from the 1987 Lowell Creek release. Of two marked adults recovered in Mayor Creek and three marked adults recovered in Jap Creek, all had originated from the 1987 Lowell Creek smolt release.

Marine Survival Rate Estimates

The emigration of 80,182 coho salmon smolts from Bear Lake in 1987 (Vincent-Lang et al. 1988) contributed adult coho salmon to the Resurrection Bay sport fishery and the Bear Lake immigration in 1988 (Table 12). The majority of these smolts were from the 1985 and 1986 fingerling plants in Bear Lake. Estimated sport harvest of coho salmon from Bear Lake in the boat and beach fisheries during 1988 was 617 fish (standard error of 88 fish) (Carlson and Vincent-Lang in press). This harvest estimate, combined with the 1988 Bear Lake coho salmon immigration of 2,192, results in an estimated marine survival rate of 3.5% (standard error of 0.1%) for the 1987 Bear Lake coho salmon smolt emigration (Table 13).

Hatchery-reared smolts released in Seward Lagoon and Lowell Creek in 1987 also contributed to the 1988 return of coho salmon to Resurrection Bay (Table 12). The estimated sport harvests of Seward Lagoon and Lowell Creek coho salmon in

Table 10. Estimated abundance, by age group, of the sockeye salmon immigration through the Bear Creek weir, 1988.

Sex		Age Group					Total
		0.3	1.2	1.3	2.2	2.3	
Male	Percent	1.4	23.9	18.4		4.2	47.9
	Est. Number	2	25	20		4	51
	Standard error	1	3	3		1	
Female	Percent		23.9	21.2	2.8	4.2	52.1
	Est. Number		25	23	3	4	55
	Standard error		3	3	1	1	
Total (n=71) ¹	Percent	1.4	47.8	39.6	2.8	8.4	100.0
	Est. Number	2	50	43	3	8	106
	Standard error	1	4	3	1	2	

¹ n = sample size.

Table 11. Mean length¹ (mm), by sex and age group, of adult sockeye salmon sampled at the Bear Creek weir, 1988.

Sex		Age Group				
		0.3	1.2	1.3	2.2	2.3
Male	Length	520	523	566		586
	Standard Error		3	2		2
	Sample Size	1	17	13		3
Female	Length		489	537	478	525
	Standard Error		2	3	2	3
	Sample Size		17	15	2	3

¹ Length measured from mid-eye to fork-of-tail.

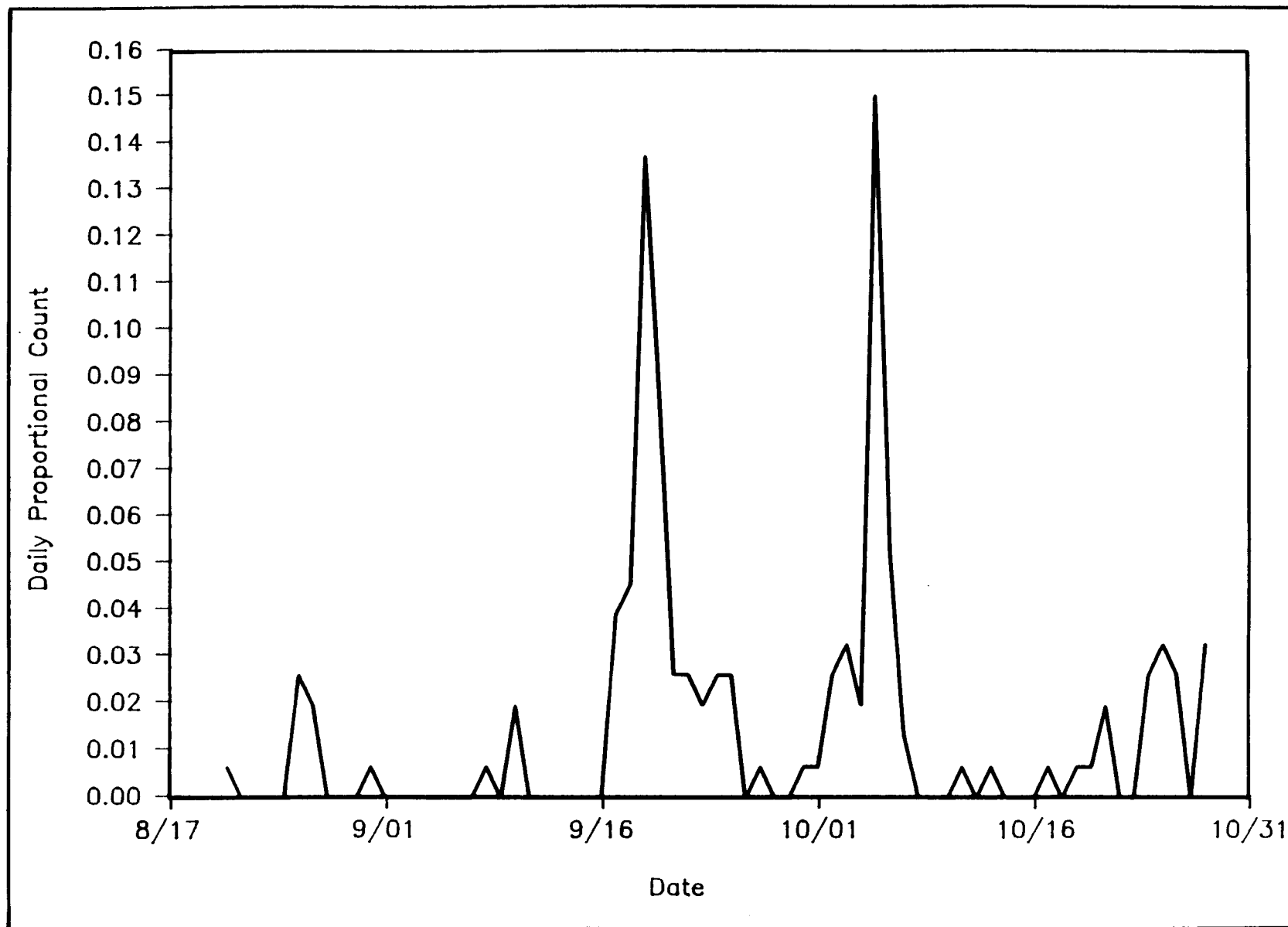


Figure 4. Migrational timing of the 1988 coho salmon immigration through Seward Lagoon weir.

Table 12. Summary of the 1985-1987 Bear Lake coho salmon fingerling plants, the 1987 Bear Lake coho salmon smolt emigration, and the 1987 hatchery-reared smolt releases contributing to the 1988 adult coho salmon return.

FINGERLING PLANTS

Brood ¹ Year	Release Date	Release Location	No. Fish Released	Stocking Data			Mark Type	No. Fish Marked
				Density (No./Acre)	Weight (Lbs)	Size (No./Lb)		
1984	6/05/85	Bear Lake	300,446	675	649	462	None	0
1985	7/09/86	Bear Lake	445,700	1,002	1,946	229	Ad-CWT ²	47,148
1986	7/07/87	Bear Lake	226,302	509	838	270	Ad-CWT ³	50,226

SMOLT EMIGRATION

Brood Year	Date	Location	No. of Emigrants	Stocking Data			Mark Type	Number Fish Marked
				Density (No./Acre)	Weight (Lbs)	Size (No./Lb)		
1983	5/18-9/15/87	Bear	259 ⁴	NA	NA		Ad-CWT ⁵	
1984	5/18-9/15/87	Creek	18,686 ⁴	NA	NA	13.7	Ad-CWT ⁵	
1985	5/18-9/15/87	Weir	61,237 ⁴	NA	NA	35.5	Ad-CWT ⁵	
		Total	80,182					23,887

-continued-

Table 12. Summary of the 1985-1987 Bear Lake coho salmon fingerling plants, the 1987 Bear Lake coho salmon smolt emigration, and the 1987 hatchery-reared smolt releases contributing to the 1988 adult coho salmon return (continued).

SMOLT RELEASES

Brood ¹ Year	Release Date	Release Location	No. Fish Released	Stocking Data			Mark Type	No. Fish Marked
				Density (No./Acre)	Weight (Lbs)	Size (No./Lb)		
1985	5/27/87	Seward Lagoon	65,514	6,423	3,074	21.3	Ad-CWT ⁶	27,173
1985	5/27/87	Lowell Creek Outfall	57,232		2,745	20.8	Ad-CWT ⁷	26,547

¹ All coho salmon plants were of Bear Lake brood stock.

² Adipose finclipped and coded wire tagged; tag code B3-13-14.

³ Adipose finclipped and coded wire tagged; tag codes B3-03-08, B3-03-09, B3-03-10, B3-03-11, and B3-15-08.

⁴ Estimated from age composition.

⁵ Adipose finclipped and coded wire tagged; tag codes 31-16-26, 31-17-51, and 31-17-52.

⁶ Adipose finclipped and coded wire tagged; tag code 31-17-43.

⁷ Adipose finclipped and coded wire tagged; tag code 31-17-41.

Table 13. Estimated smolt-to-adult survivals of hatchery-reared coho salmon smolts emigrating from Bear Lake and released into Seward Lagoon and Lowell Creek in 1987.

Location	Number of Smolts	Sport Harvest ¹		Escapement	Survival	
		Number	SE ²		Percent	SE ²
Bear Lake	80,182 ³	617	88	2,192 ⁵	3.5	0.1
Seward Lagoon	65,514 ⁴	4,124	417	137 ⁶	6.6	0.6
Lowell Creek Outfall	57,232 ⁴	3,328	357	--- ⁷	5.8	0.6

¹ Reported in Carlon and Vincent-Lang (in press).

² Standard error (expressed as a percent).

³ The number of live smolts that emigrated past the Bear Creek weir in 1987.

⁴ The number of hatchery-reared smolts stocked into this location in 1986.

⁵ Escapement of coho salmon to the Bear Creek weir (2,174) plus to lower Bear Creek (18).

⁶ The estimated minimum escapement of smolts stocked into 1987.

⁷ A waterfall at the Lowell Creek outfall presents a physical barrier to fish migration and precludes spawning in this system. There is no escapement to this creek; fish surplus to the harvest stray to other systems or perish in saltwater. The survival rate is therefore a minimum.

the 1988 boat and beach fisheries were 4,124 (standard error of 417) and 3,328 fish (standard error of 357 fish), respectively (Carlton and Vincent-Lang in press). These estimates and escapement (Seward Lagoon only) counts (Table 9) yield estimated minimum marine survival rates of 6.6% (standard error of 0.6%) and 5.8% (standard error of 0.6%), respectively, for smolts stocked in Seward Lagoon and Lowell Creek during 1987 (Table 13).

RECOMMENDATIONS

The proportional contribution of stocked coho salmon to the 1988 recreational marine boat fishery was nearly double the historical average (Carlton and Vincent-Lang in press). Given that this occurred when the recreational harvest was the second lowest since 1968 (37% below the mean harvest for the years 1968 through 1987), this indicates a decreased contribution of wild stocks to the Resurrection Bay recreational fisheries, a trend that has been observed in recent years. While it is assumed a flood in October of 1986 affected survival of the cohorts returning in 1988, the extent is unknown as is the relationship of freshwater juvenile production to other factors influencing spawning and rearing habitat in the Resurrection River drainage. Given this, we recommend:

1. The proportional contribution of stocked fish to the marine sport fisheries be continued to be examined.
2. The assessment of smolt production from the annual stockings of fingerlings into Bear Lake be continued to be examined to evaluate the effect of the stocking strategies stipulated in Vincent-Lang et al. (1987).
3. Spawning and rearing habitats of the Resurrection River drainage should be explored to determine factors influencing their relationship to natural salmonid production.

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APPENDIX

Appendix Table 1. Daily emigration of coho and sockeye salmon smolts from Bear Lake, 1988.

Date	Coho Salmon Smolts			Sockeye Salmon Smolts		
	Dead	Live	Total	Dead	Live	Total
5/16	0	8	8			
5/17	0	1	1			
5/18	0	0	0			
5/19	0	3	3			
5/20	0	4	4			
5/21	0	0	0			
5/22	0	0	0			
5/23	1	1	2			
5/24	0	0	0			
5/25	0	0	0			
5/26	1	32	33	0	70	70
5/27	2	31	33	0	36	36
5/28	0	0	0	0	0	0
5/29	0	0	0	0	0	0
5/30	0	0	0	0	0	0
5/31	0	15	15	0	0	0
6/01	0	41	41	0	3	3
6/02	0	555	555	0	984	984
6/03	0	120	120	0	1	1
6/04	4	406	410	3	3,572	3,575
6/05	0	0	0	0	0	0
6/06	1	398	399	0	12	12
6/07	0	0	0	0	0	0
6/08	2	4,527	4,529	0	275	275
6/09	3	2,278	2,281	0	73	73
6/10	9	4,389	4,398	0	104	104
6/11	0	4,627	4,627	0	158	158
6/12	1	1,092	1,093	0	28	28
6/13	3	6,218	6,221	0	183	183
6/14	2	4,499	4,501	0	103	103
6/15	7	5,265	5,272	0	74	74
6/16	3	5,270	5,273	0	362	362
6/17	1	2,996	2,997	0	98	98
6/18	1	929	930	0	25	25
6/19	0	2,364	2,364	0	256	256
6/20	1	2,662	2,663	0	495	495
6/21	1	1,331	1,332	0	201	201
6/22	0	604	604	0	200	200
6/23	0	1,457	1,457	0	241	241
6/24	0	948	948	1	46	47
6/25	1	1,960	1,961	0	482	482
6/26	0	135	135	0	2	2

- continued -

Appendix Table 1. Daily emigration of coho and sockeye salmon smolts from Bear Lake, 1988 (continued).

Date	Coho Salmon Smolts			Sockeye Salmon Smolts		
	Dead	Live	Total	Dead	Live	Total
6/27	0	1,816	1,816	0	187	187
6/28	0	1,151	1,151	0	216	216
6/29	0	1,305	1,305	0	46	46
6/30	2	911	913	0	40	40
7/01	0	408	408	0	44	44
7/02	0	297	297	0	119	119
7/03	0	721	721	0	75	75
7/04	0	408	408	0	82	82
7/05	0	175	175	0	4	4
7/06	5	75	80	0	3	3
7/07	0	119	119	0	1	1
7/08	0	154	154	0	2	2
7/09	1	53	54	0	1	1
7/10	1	153	154	0	7	7
7/11	0	63	63	0	0	0
7/12	0	0	0	0	0	0
7/13	0	267	267	0	31	31
7/14	0	0	0	0	0	0
7/15	0	321	321	0	148	148
7/16	0	41	41	0	5	5
7/17	0	15	15	0	1	1
7/18	0	0	0	0	0	0
7/19	0	1	1	0	1	1
7/20	0	0	0	0	0	0
7/21	0	0	0	0	0	0
7/22	0	0	0	0	0	0
7/23	0	0	0	0	0	0
7/24	2	133	135	0	43	43
7/25	0	0	0	0	0	0
7/26	0	1	1	0	1	1
7/27	0	1	1	0	0	0
7/28	0	0	0	0	0	0
7/29	0	0	0	0	0	0
7/30	0	0	0	0	0	0
7/31	0	0	0	0	0	0
8/01	0	0	0	0	0	0
8/02	0	0	0	0	0	0
8/03	0	14	14	0	0	0
8/04	0	0	0	0	0	0
8/05	0	0	0	0	0	0
8/06	0	0	0	0	0	0
8/07	0	0	0	0	0	0

- continued -

Appendix Table 1. Daily emigration of coho and sockeye salmon smolts from Bear Lake, 1988 (continued).

Date	Coho Salmon Smolts			Sockeye Salmon Smolts		
	Dead	Live	Total	Dead	Live	Total
8/08	0	3	3	0	0	0
8/09	0	0	0	0	0	0
8/10	0	0	0	0	0	0
8/11	0	3	3	0	0	0
8/12 ¹	0	0	0	0	0	0
Total	55	63,775	63,830	4	9,141	9,145

¹ Downstream migrant trap was closed at 10:00 p.m., 8/12/88 to prevent straying juvenile salmonids from washing downstream.

Appendix Table 2. Daily immigration of coho salmon through the Bear Creek weir, 1988.

Date	Males			Females			Daily Total	Marked Fish ¹
	Dead	Live	Total	Dead	Live	Total		
8/25	0	0	0	0	0	0	0	0
8/26	0	2	2	0	0	0	2	1
8/27	0	1	1	0	0	0	1	0
8/28	0	0	0	0	0	0	0	0
8/29	0	2	2	0	1	1	3	2
8/30	0	0	0	0	0	0	0	0
8/31	0	7	7	0	1	1	8	4
9/01	0	19	19	0	1	1	20	10
9/02	0	1	1	0	0	0	1	0
9/03	0	9	9	0	1	1	10	4
9/04	0	24	24	0	4	4	28	8
9/05	0	22	22	0	2	2	24	9
9/06	0	34	34	0	10	10	44	17
9/07	1	28	29	0	16	16	45	17
9/08	0	5	5	0	8	8	13	4
9/09	0	13	13	0	2	2	15	5
9/10	0	42	42	0	18	18	60	15
9/11	0	71	71	0	48	48	119	46
9/12	0	140	140	0	117	117	257	113
9/13	0	134	134	0	135	135	269	116
9/14	0	58	58	0	65	65	123	49
9/15	0	53	53	0	52	52	105	36
9/16	0	24	24	0	11	11	35	11
9/17	0	39	39	0	35	35	74	29
9/18	0	61	61	0	78	78	139	52
9/19	0	60	60	0	79	79	139	56
9/20	0	47	47	0	72	72	119	38
9/21	0	29	29	0	53	53	82	28
9/22	0	22	22	0	34	34	56	26
9/23	0	16	16	0	18	18	34	12
9/24	0	14	14	0	28	28	42	18
9/25	0	6	6	0	15	15	21	5
9/26	0	5	5	0	11	11	16	6
9/27	0	8	8	0	7	7	15	4
9/28	0	4	4	0	7	7	11	4
9/29	0	4	4	0	7	7	11	5
9/30	0	0	0	0	4	4	4	1
10/01	0	4	4	0	2	2	6	2

- continued -

Appendix Table 2. Daily immigration of coho salmon through the Bear Creek weir, 1988 (continued).

Date	Males			Females			Daily Total	Marked Fish ¹
	Dead	Live	Total	Dead	Live	Total		
10/02	0	7	7	0	3	3	10	4
10/03	0	5	5	0	18	18	23	5
10/04	0	5	5	0	6	6	11	3
10/05	0	28	28	0	27	27	55	11
10/06	0	13	13	0	21	21	34	10
10/07	0	10	10	0	14	14	24	9
10/08	0	10	10	0	13	13	23	8
10/09	0	7	7	0	8	8	15	4
10/10	0	2	2	0	3	3	5	2
10/11	0	5	5	0	3	3	8	2
10/12	0	0	0	0	1	1	1	0
10/13	0	2	2	0	0	0	2	0
10/14	0	1	1	0	0	0	1	0
10/15	0	0	0	0	0	0	0	0
10/16	0	0	0	0	0	0	0	0
10/17	0	0	0	0	0	0	0	0
10/18	0	1	1	0	0	0	1	0
10/19	0	1	1	0	0	0	1	1
10/20	0	2	2	0	3	3	5	1
10/21	0	1	1	0	1	1	2	1
10/22	0	0	0	0	0	0	0	0
10/23	0	0	0	0	0	0	0	0
10/24	0	0	0	0	0	0	0	0
10/25	0	0	0	0	0	0	0	0
10/26	0	0	0	0	0	0	0	0
10/27	0	1	1	0	0	0	1	0
10/28	0	0	0	0	0	0	0	0
10/29	0	0	0	0	0	0	0	0
10/30	0	0	0	0	0	0	0	0
10/31	0	0	0	0	0	0	0	0
11/01	0	1	1	0	0	0	1	0
11/02 ⁴	0	0	0	0	0	0	0	0
Total	1	1,110	1,111 ²	0	1,063	1,063 ³	2,174	814

¹ Adipose finclipped and coded wire tagged.

² Of 1,111 males returning to the weir, a total of 155 males were killed to fertilize the 1988 egg-take.

³ Of 1,063 females returning to the weir, a total of 378 females were killed for the 1988 egg-take.

⁴ Weir operations were ceased at 3:00pm, 11/02/88.

Appendix Table 3. Daily immigration of sockeye salmon through the Bear Creek weir, 1988.

Date	Males			Females			Daily Total
	Dead	Live	Total	Dead	Live	Total	
6/01	0	0	0	0	0	0	0
6/02	0	0	0	0	1	1	1
6/03	0	1	1	0	0	0	1
6/04	0	1	1	0	1	1	2
6/05	0	0	0	0	0	0	0
6/06	0	2	2	0	1	1	3
6/07	0	0	0	0	0	0	0
6/08	0	3	3	0	2	2	5
6/09	0	1	1	0	1	1	2
6/10	0	2	2	0	2	2	4
6/11	0	4	4	0	1	1	5
6/12	0	2	2	0	5	5	7
6/13	0	0	0	0	1	1	1
6/14	0	4	4	0	7	7	11
6/15	0	3	3	0	1	1	4
6/16	0	5	5	0	5	5	10
6/17	0	2	2	0	2	2	4
6/18	0	1	1	0	1	1	2
6/19	0	2	2	0	1	1	3
6/20	0	1	1	0	7	7	8
6/21	0	1	1	0	1	1	2
6/22	0	1	1	0	0	0	1
6/23	0	0	0	0	0	0	0
6/24	0	2	2	0	0	0	2
6/25	0	0	0	0	1	1	1
6/26	0	1	1	0	0	0	1
6/27	0	1	1	0	1	1	2
6/28	0	1	1	0	0	0	1
6/29	0	2	2	0	4	4	6
6/30	0	1	1	0	0	0	1
7/01	0	0	0	0	0	0	0
7/02	0	0	0	0	0	0	0
7/03	0	0	0	0	0	0	0
7/04	0	0	0	0	0	0	0
7/05	0	1	1	0	0	0	1
7/06	0	0	0	0	1	1	1
7/07	0	0	0	0	0	0	0
7/08	0	0	0	0	1	1	1
7/09	0	0	0	0	0	0	0

- continued -

Appendix Table 3. Daily immigration of sockeye salmon through the Bear Creek weir, 1988 (continued).

Date	Males			Females			Daily Total
	Dead	Live	Total	Dead	Live	Total	
7/10	0	0	0	0	1	1	1
7/11	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0
7/13	0	0	0	0	0	0	0
7/14	0	0	0	0	0	0	0
7/15	0	0	0	0	0	0	0
7/16	0	0	0	0	0	0	0
7/17	0	0	0	0	0	0	0
7/18	0	0	0	0	0	0	0
7/19	0	1	1	0	0	0	1
7/20	0	0	0	0	0	0	0
7/21	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0
7/23	0	0	0	0	0	0	0
7/24	0	0	0	0	0	0	0
7/25	0	0	0	0	0	0	0
7/26	0	0	0	0	0	0	0
7/27	0	0	0	0	0	0	0
7/28	0	0	0	0	0	0	0
7/29	0	0	0	0	0	0	0
7/30	0	1	1	0	0	0	1
7/31	0	1	1	0	1	1	2
8/01	0	0	0	0	0	0	0
8/02	0	0	0	0	0	0	0
8/03	0	0	0	0	0	0	0
8/04	0	0	0	0	0	0	0
8/05	0	0	0	0	0	0	0
8/06	0	0	0	0	0	0	0
8/07	0	0	0	0	0	0	0
8/08	0	0	0	0	0	0	0
8/09	0	0	0	0	0	0	0
8/10	0	0	0	0	0	0	0
8/11	0	1	1	0	0	0	1
8/12	0	0	0	0	0	0	0
8/13	0	0	0	0	0	0	0
8/14	0	0	0	0	0	0	0
8/15	0	0	0	0	0	0	0
8/16	0	0	0	0	0	0	0
8/17	0	0	0	0	0	0	0

- continued -

Appendix Table 3. Daily immigration of sockeye salmon through the Bear Creek weir, 1988 (continued).

Date	Males			Females			Daily Total
	Dead	Live	Total	Dead	Live	Total	
8/18	0	0	0	0	0	0	0
8/19	0	0	0	0	0	0	0
8/20	0	0	0	0	0	0	0
8/21	0	0	0	0	0	0	0
8/22	0	0	0	0	0	0	0
8/23	0	0	0	0	0	0	0
8/24	0	0	0	0	0	0	0
8/25	0	0	0	0	0	0	0
8/26	0	0	0	0	0	0	0
8/27	0	0	0	0	0	0	0
8/28	0	0	0	0	0	0	0
8/29	0	0	0	0	0	0	0
8/30	0	0	0	0	0	0	0
8/31	0	0	0	0	0	0	0
9/01	0	0	0	0	0	0	0
9/02	0	0	0	0	0	0	0
9/03	0	1	1	0	0	0	1
9/04	0	0	0	0	0	0	0
9/05	0	0	0	0	0	0	0
9/06	0	0	0	0	0	0	0
9/07	0	0	0	0	0	0	0
9/08	0	0	0	0	0	0	0
9/09	0	0	0	0	0	0	0
9/10	0	0	0	0	0	0	0
9/11	0	1	1	0	0	0	1
9/12	0	0	0	0	0	0	0
9/13	0	0	0	0	0	0	0
9/14	0	0	0	0	0	0	0
9/15	0	0	0	0	0	0	0
9/16	0	0	0	0	1	1	1
9/17	0	0	0	0	0	0	0
9/18	0	0	0	0	0	0	0
9/19	0	1	1	0	0	0	1
9/20	0	0	0	0	1	1	1
9/21	0	0	0	0	0	0	0
9/22	0	0	0	0	0	0	0
9/23	0	0	0	0	0	0	0
9/24	0	1	1	0	0	0	1
9/25	0	0	0	0	0	0	0

- continued -

Appendix Table 3. Daily immigration of sockeye salmon through the Bear Creek weir, 1988 (continued).

Date	Males			Females			Daily Total
	Dead	Live	Total	Dead	Live	Total	
9/26	0	0	0	0	0	0	0
9/27	0	0	0	0	0	0	0
9/28	0	0	0	0	0	0	0
9/29	0	0	0	0	0	0	0
9/30	0	0	0	0	0	0	0
10/01	0	0	0	0	0	0	0
10/02	0	0	0	0	0	0	0
10/03	0	0	0	0	0	0	0
10/04	0	0	0	0	0	0	0
10/05	0	0	0	0	0	0	0
10/06	0	1	1	0	0	0	1
Total	0	54	54	0	52	52	106

Appendix Table 4. Daily immigrations of coho, chinook, and sockeye salmon through the Seward Lagoon weir, 1988.

Date	Coho Salmon	Marked Coho Salmon ¹	Chinook Salmon	Marked Chinook Salmon ²	Sockeye Salmon
6/14	0	0	1	0	0
6/15	0	0	0	0	0
6/16	0	0	0	0	0
6/17	0	0	0	0	0
6/18	0	0	0	0	0
6/19	0	0	0	0	0
6/20	0	0	0	0	0
6/21	0	0	0	0	0
6/22	0	0	0	0	0
6/23	0	0	0	0	0
6/24	0	0	0	0	0
6/25	0	0	7	0	0
6/26	0	0	1	0	0
6/27	0	0	0	0	0
6/28	0	0	1	0	0
6/29	0	0	3	0	0
6/30	0	0	3	0	0
7/01	0	0	3	0	0
7/02	0	0	0	0	2
7/03	0	0	0	0	0
7/04	0	0	1	0	0
7/05	0	0	1	0	0
7/06	0	0	1	0	0
7/07	0	0	0	0	0
7/08	0	0	1	0	0
7/09	0	0	0	0	1
7/10	0	0	0	0	0
7/11	0	0	0	0	0
7/12	0	0	0	0	0
7/13	0	0	0	0	0
7/14	0	0	0	0	0
7/15 ³	0	0	0	0	0
7/16 ³	0	0	0	0	0
7/17 ³	0	0	0	0	0
7/18 ³	0	0	0	0	0
7/19	0	0	0	0	0
7/20	0	0	0	0	0
7/21	0	0	0	0	0
7/22	0	0	0	0	0

- continued -

Appendix Table 4. Daily immigrations of coho, chinook, and sockeye salmon through the Seward Lagoon weir, 1988 (continued).

Date	Coho Salmon	Marked Coho Salmon ¹	Chinook Salmon	Marked Chinook Salmon ²	Sockeye Salmon
7/23	0	0	0	0	0
7/24	0	0	0	0	0
7/25	0	0	1	0	0
7/26	0	0	0	0	7
7/27	0	0	0	0	2
7/28	0	0	0	0	0
7/29	0	0	0	0	1
7/30	0	0	0	0	1
7/31	0	0	0	0	1
8/01	0	0	0	0	0
8/02	0	0	0	0	0
8/03	0	0	0	0	0
8/04	0	0	0	0	0
8/05	0	0	0	0	0
8/06	0	0	0	0	0
8/07	0	0	0	0	0
8/08	0	0	0	0	0
8/09	0	0	0	0	0
8/10	0	0	0	0	0
8/11	0	0	0	0	0
8/12	0	0	0	0	0
8/13	0	0	0	0	0
8/14	0	0	0	0	0
8/15	0	0	0	0	0
8/16	0	0	0	0	0
8/17	0	0	0	0	0
8/18	0	0	0	0	0
8/19	0	0	0	0	0
8/20	0	0	0	0	0
8/21	1	0	0	0	1
8/22	0	0	0	0	0
8/23	0	0	0	0	0
8/24	0	0	1	1	0
8/25	0	0	1	1	0
8/26	4	3	0	0	0
8/27	3	1	0	0	0
8/28	0	0	1	1	0
8/29	0	0	0	0	0
8/30	0	0	0	0	0

- continued -

Appendix Table 4. Daily immigrations of coho, chinook, and sockeye salmon through the Seward Lagoon weir, 1988 (continued).

Date	Coho Salmon	Marked Coho Salmon ¹	Chinook Salmon	Marked Chinook Salmon ²	Sockeye Salmon
8/31	1	1	0	0	2
9/01	0	0	0	0	0
9/02	0	0	0	0	0
9/03	0	0	0	0	0
9/04	0	0	0	0	0
9/05	0	0	0	0	0
9/06	0	0	0	0	0
9/07	0	0	0	0	0
9/08	1	0	0	0	0
9/09	0	0	0	0	0
9/10	3	0	0	0	0
9/11	0	0	0	0	0
9/12	0	0	0	0	0
9/13	0	0	0	0	0
9/14	0	0	0	0	0
9/15	0	0	0	0	0
9/16	0	0	0	0	0
9/17	6	2	0	0	0
9/18	7	3	0	0	0
9/19	21	8	0	0	0
9/20	13	3	0	0	0
9/21	4	0	0	0	0
9/22	4	0	0	0	0
9/23	3	2	0	0	0
9/24	4	0	0	0	0
9/25	4	1	0	0	0
9/26	0	0	0	0	0
9/27 ³	1	0	0	0	0
9/28 ³	0	0	0	0	0
9/29 ³	0	0	0	0	0
9/30 ³	1	0	0	0	0
10/01	1	1	0	0	0
10/02	4	2	0	0	0
10/03	5	1	0	0	0
10/04	3	2	0	0	0
10/05	23	5	0	0	0
10/06	8	3	0	0	0
10/07	2	2	0	0	0
10/08	0	0	0	0	0

- continued -

Appendix Table 4. Daily immigration of coho, chinook, and sockeye salmon through the Seward Lagoon weir, 1988 (continued).

Date	Coho Salmon	Marked Coho Salmon ¹	Chinook Salmon	Marked Chinook Salmon ²	Sockeye Salmon
10/09	0	0	0	0	0
10/10	0	0	0	0	0
10/11	1	0	0	0	0
10/12	0	0	0	0	0
10/13	1	0	0	0	0
10/14	0	0	0	0	0
10/15	0	0	0	0	0
10/16	0	0	0	0	0
10/17	1	0	0	0	0
10/18	0	0	0	0	0
10/19	1	0	0	0	0
10/20	1	0	0	0	0
10/21	3	0	0	0	0
10/22	0	0	0	0	0
10/23	0	0	0	0	0
10/24	4	3	0	0	0
10/25	5	1	0	0	0
10/26	4	2	0	0	0
10/27	0	0	0	0	0
10/28	5	2	0	0	0
Total	153 ³	48	27	3 ²	18

¹ Adipose finclipped and coded wire tagged.

² Adipose finclipped and coded wire tagged chinook salmon of late-run, Kenai River origin.

³ Due to vandalism of the Seward Lagoon weir, fish were allowed to pass undetected during at least 4 days on two separate occasions and portions of days on several other occasions.

